REMARKS

Reconsideration of the present application, as amended, is respectfully requested. Claims 29-35, and 38-50 of the present application are currently pending. Claims 29, 32-34, 38, and 40-41 have been amended to better reflect the invention, and new claims 42-50 have been added.

35 U.S.C. § 103 Rejections

The Examiner has rejected claims 29, 30, 31, 33, and 34 under 35 U.S.C. § 103(a) as being unpatentable over Japanese Pat. JP05-198512 by Itsudo, et al. (hereinafter, "Itsudo"), in view of U.S. Pat. 5,531,183 by Sivaramakrishnam, et al. (hereinafter, "Sivaramakrishnam"). In light of the amendment, the Examiner's rejections have become moot. Nonetheless, the following remarks regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

Applicant's invention relates to a wafer processing apparatus, such as a chemical vapor deposition (CVD) apparatus. The apparatus comprises a processing chamber having an upper wall; a manifold component located on the upper wall of the processing chamber, defining a manifold cavity; a **processing gas** supply line connected to the manifold component for providing a **processing gas**, wherein the **processing gas** comprises **non-depleted reactive gases** used for processing the wafer; wherein the upper wall comprises a plurality of processing gas supply openings, which are **non-uniformly distributed** over the upper wall to create a flow pattern comprising a predominantly **vertical flow of processing gas** onto the wafer and **mixing the resulting exhaust gases** with **non-uniformly distributed amounts of**

processing gas depending upon the position of the point of mixing relative to the exhaust line. Processing gas, which have not yet reacted with the wafer, comprise non-depleted reactive gases, while exhaust gases have had some reaction with the wafer, and thus, the processing gas has become depleted of some reactive gas.

Referring to figure 10, in the specifications, the processing gas which descends onto the right side of the wafer, the region furthest from the exhaust line, reacts with or over the wafer and the resulting exhaust gas may then comprise a depleted processing gas and some reacted gases. In an embodiment, the resulting exhaust gases move to the left, or the next region closer to the exhaust line. This exhaust gas is then mixed with new processing gas from the processing gas openings above the exhaust gas flow. The mixture of new processing gas and the exhaust gas comprising depleted processing gas, may be capable of replenishing the depleted processing gas. The mixture then reacts with or over the wafer and depletes the mixture's processing gas and moves further to the left, or the next region closer to the exhaust line. The mixture is again replenished with new processing gas from the processing gas openings above, and the cycle of reaction, depletion, and replenishing of processing gas repeats as the exhaust gases move across the wafer to the exhaust line. The resulting mixtures of exhaust gases may be constantly replenished with new processing gas from the processing gas openings above, and thus, may provide a nearly consistent concentration of processing gas above the wafer as the exhaust gases traverse the wafer.

In contrast, Itsudo fails to disclose or suggest a processing gas supply line connected to the manifold component for providing processing gas, nor processing gas supply openings in the upper wall to create a flow pattern comprising a predominantly vertical flow of processing gas onto the wafer, nor mixing the resulting exhaust gases with non-uniformly distributed amounts of processing gas depending upon the position of the point of mixing

relative to the exhaust line. As shown in figure 1 of Itsudo, the processing gas 25 is introduced directly into the processing chamber and not through the openings 30 in the upper wall. As a result, the processing gas flows **horizontally** from the supply line 23 on the right, across the wafer 22 to the exhaust line 24 on the left. After the process gases react with the wafer on the right side, the resulting exhaust gases contain a depleted processing gas and reacted gases, which then mix with non-reactive gases from the openings above. There is **no vertical flow of processing gases to replenish** the exhaust gases as they move across the wafer. Instead, the concentration of processing gases are **diluted further** by mixing in non-reactive gases from above. As the mixed gas move to the left, toward the exhaust line, more of the remaining reactive processing gases are consumed and more non-reactive gases are mixed in to dilute the exhaust gases even further. The result is, that in Itsudo, the concentration of reactive processing gases **must continuously decrease** as the exhaust gases move across the wafer being processed. In fact, Itsudo **teaches away** from applicant's invention because Itsudo discloses **diluting** the reactive processing gases with **non-reactive gases** as the gases move across the wafer, while applicant's invention discloses **replenishing** the gases with **new reactive processing gases**, thus permitting a **constant concentration** of reactive processing gases.

Similarly, Sivaramakrishnam fails to remedy the deficiencies of Itsudo because Sivaramakrishnam fails to disclose or suggest a processing gas supply line connected to the **manifold component** for providing processing gas, nor processing gas supply **openings in the upper wall** to create a flow pattern, nor mixing the resulting exhaust gases with **non-uniformly distributed** amounts of processing gas depending upon the position of the point of mixing relative to the exhaust line. Examiner asserts that in Sivaramakrishnam, figure 2, el. 38, Sivaramakrishnam discloses a manifold cavity, but a tube is not equivalent to a

manifold cavity. A manifold cavity provides a ballast in the system, which helps absorb fluctuations in the system and helps provide a much more uniform output to subsequent system components, and thus improves process uniformity. A tube has little or no ballast, and thus results in a noisier system with less process uniformity, which results in forming less uniform layers.

Furthermore, Sivaramakrishnam fails to disclose or suggest an upper wall of the processing chamber having openings for supplying processing gases. Instead, it appears that processing gas is supplied to the processing chamber through a showerhead 14, in figure 2, having openings. A showerhead is not equivalent to the upper wall of the chamber. Further, the openings are uniformly distributed and thus fail to provide the flow pattern resulting from the mixing of non-uniformly distributed amounts of processing gas with exhaust gases moving across the wafer.

In addition, Sivaramakrishnam is not combinable with Itsudo because the references disclose systems that produce very different and incompatible flow patterns. The references are drawn to equipment for processing semiconductor wafers, specifically to deposit or form very thin and very uniform layers, in some cases only a few atoms thick over extremely large areas relative to the thicknesses being formed. If the layer formed is too thick or too thin, even if in an area less than a micron in diameter, may result in the entire device becoming degraded or failed. The semiconductor industry has had a long felt need, for decades, to produce thinner layers with better uniformity, which is far from a trivial problem. An important element in the development of such thin and uniform layers has been closely related to the flow patterns of processing gases over the wafer. A skilled

artisan would know that even small changes in the flow pattern of processing gases are likely to result in dramatic changes in deposition characteristics and that a great deal of effort is required to optimize a given flow pattern to produce the requisite layer thicknesses and uniformity, if even possible. Consequently, a "mere rearrangement of parts" that results in significant changes in process gas flow patterns is likely to result in substantial changes in the depositions on wafers, and most likely would require undue experimentation to obtain any improvement, if at all.

Therefore, it would not be obvious to modify Itsudo, as a mere rearrangement of parts, which would result in changing the horizontal, progressively depleted processing gas flow pattern to a vertical non-uniform replenishing processing gas flow pattern. Further, Itsudo and Sivaramakrishnam are not compatible because Sivaramakrishnam discloses a vertical shower of processing gas with the exhaust gases moving radially outward, while Itsudo discloses a horizontal processing gas and exhaust gas flow moving across the wafer to one side. Furthermore, there is no motivation in either reference to non-uniformly replenish the exhaust gases with processing gas relative to the exhaust line to provide a consistent level of processing gas across the entire wafer.

The Examiner asserts as obvious, to modify Itsudo, but such modifications would radically change the flow pattern of the processing gas, which is not suggested by any of the prior art of record. Later, it is asserted that the claimed flow pattern is an inherent function of a substantially identical apparatus. However, if

the apparatus are substantially identical, then why do they have radically different flow patterns? Applicants assert that the claimed apparatus is substantially different, producing substantially different flow patterns, and the combination of Itsudo and Sivaramakrishnam is a result of hindsight reasoning.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

35 U.S.C. § 103 Rejections

The Examiner has rejected claims 32, 35, 38, 39, and 40 under 35 U.S.C. § 103(a) as being unpatentable over Japanese Pat. JP05-198512 by Itsudo, et al. (hereinafter, "Itsudo") and U.S. Pat. 5,531,183 by Sivaramakrishnam, et al. (hereinafter, "Sivaramakrishnam") in view of U.S. Pat. 6,444,039 by Nguyen (hereinafter, "Nguyen").

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim. Nonetheless, the following remarks regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

Nguyen is introduced to disclose a gas distribution plate having angular displacement. However, Nguyen fails to remedy the deficiencies discussed above. Nguyen fails to disclose or suggest an upper wall of the processing chamber having openings for supplying

processing gases. Instead, it appears that processing gas is supplied to the processing chamber through a showerhead having openings. A showerhead is not equivalent to the upper wall of the chamber. Further, the openings are uniformly distributed and thus fail to provide the flow pattern resulting from the mixing of non-uniformly distributed amounts of processing gas with exhaust gases moving across the wafer.

In conclusion, the claims, as amended, are asserted to overcome the Examiner's rejections and the claims are believed to be in condition for allowance. Applicants respectfully request reconsideration of this application as amended.

New Claims

Applicant has added new claims 42-50, of which claims 42 and 47 are independent claims. In light of the above remarks, and that claim 42 comprises the limitation that the openings be **non-uniformly distributed** over the upper wall, and wherein the **openings**, **manifold cavity**, processing gas **supply** and **exhaust** systems, **predominantly determine the flow pattern** of the processing gas, which may be capable of a **consistent uniform processing** across the entire wafer. The flow patterns in the prior art of record are predominantly determined by other components, such as, a gas supply line **directly to the processing chamber**, or a **showerhead** over the wafer, and **not predominantly** by the components claimed, nor do the prior art of record provide a **consistent uniform concentration of reactive processing gas** across the entire wafer, as discussed above. Claim 47 comprises the claim limitation that the openings are **distributed non-uniformly** over the **upper wall**, creating a predominantly **vertical flow pattern** of processing gas. As discussed

above, Itsudo does not disclose nor suggest a **vertical flow pattern.** Sivaramakrishnam and Nguyen do not disclose openings distributed **non-uniformly** over the **upper wall**. Further, the prior art of record fails to be combinable because the flow patterns they produce are not compatible, nor obvious and would at best require undue experimentation.

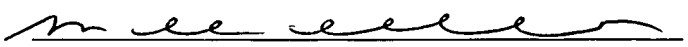
Applicant respectfully submits that the present application is in condition for allowance. If the Examiner believes a telephone conference would expedite or assist in the allowance of the present application, the Examiner is invited to call Michael A. Bernadicou at (408) 720-8300.

Pursuant to 37 C.F.R. 1.136(a)(3), applicant(s) hereby request and authorize the U.S. Patent and Trademark Office to (1) treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time and (2) charge all required fees, including extension of time fees and fees under 37 C.F.R. 1.16 and 1.17, to Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: January 3, 2006



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